Warning: You Are Already Behind Schedule.

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May 1997

A little advice from the students before you…

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Everybody wants more time to finish 370. You spend the first two months of the course choosing and defining a project, dealing with group dynamics, and investigating design options. With a month of school left, midterms to write and finals around the corner, the workload of your project will increase by an order of magnitude. In the past, a few groups have built demanding projects and distributed the workload across the entire semester, but most groups experience an incredible crunch at the end. You have the opportunity to bring it together now. So one more time, read and think about the warning label above.

The next few pages contain simple advice and suggestions which seem like common sense. Unfortunately, common sense oozes into the lab carpets late at night and turns them a dull brown. Read this now and read it again later. It may only save you a few hours work; it may well save you a week. It *will* save you a lot of suffering.

Choosing a Group

The most successful group is comprised entirely of people who share the same goals and the same vision of how to achieve those goals. If there are differences in ideas, ambition or habits, compromises will have to be made. Problems occur when the mechanisms of negotiating a satisfactory compromise break down. Try to select group members who work the same as you do, or work in a manner you are willing to accommodate.

You can form a group with friends. You already understand your friends, how they work, what they like, what drives them around the bend. While you remain friends, lines of communication are always open, and often less organization is needed to accomplish your goals. Unfortunately, interaction between members is often more personal, and you can too easily destroy a friendship. This has happened in the past. You can form a group with classmates. You will need to expend effort on structure and organization because good communication between members is not inherent. Interaction between members is less personal. Think carefully before mixing a group with friends and classmates. Communication between the two types of members will be different. Interrelationships will be different. Will the classmates be left out? It does happen.

Sometimes a group feels choosing a leader is important. The hierarchy in a company is established over years, and you do not have years. Picking a leader is artificial. Do you really need a leader, or do you need an organizer or coordinator? True leadership might emerge over the course of the semester, but do not try and force it.

Group size is another issue of importance. A group of three is the smallest practical size for a 370 project. Steve will discuss in detail the interrelationships between three people in a group; it may not sound attractive from the group dynamics perspective. But consider the group size from an engineering perspective: fewer people means more opportunity to learn what other group members are working on. As group size expands and the project is split between many people,

issues of integration become a large concern. Students at this level are amateurs at integration, and the associated problems may be so severe that adding members makes a group less productive. Of course, 370 is a good forum to learn about integration; maybe you want the challenge. The largest projects require more people to do the work, you can't get away with a small group. If you are considering a project which requires more than five people, split the project into two separate sub-projects.

Choosing a Project

Choose a project you enjoy. Some groups choose a project because one or more members want to build and keep their device. Some groups choose a project which involves learning specific skills. Others simply choose something cool.

Choose a project which allows you to follow the 370-305 process: *choose a problem to solve.* You do not want to choose a design. Later in the process, you must come up with a design which is the best solution to the problem. So if your problem is a design, how do you show your design is the best solution?

You may propose a project, be gung-ho super keen on the hottest idea to hit the lab in years, and then the feedback on your project proposal is negative. The instructors and TA's are not here to bruise egos, they are here to help. Take a very close look at their concerns.

In 370 you are supposed to dream big and narrow the scope of the project later. Think ahead to what compromises you might make. If these compromises are detrimental to your enjoyment of this project, choose another one. Now think ahead to the cost and availability of parts. Can you surmount the problems with ingenuity of design? Can you find alternate sources of funds? You might come up with a phenomenal solution, or you might be frustrated for a whole semester. Choose your project carefully.

Falling Behind

The biggest complaint about 370-305 is the amount of time available for implementation of the project. Many students wish they had been warned. Consider this your warning.

Look at your 305 schedule. The design document is due in the first week of March. When the design document is complete, you walk into the lab and implement your design… right? Or are pieces still missing? *The design document is for you, not Andrew.* If your design document does not have full schematics, algorithms, and flowcharts, your design is not complete. The document can be handed in without these details (as most groups do), but why leave such important work so late in the semester? If you want to smooth the project workload over the semester, follow the 305 process carefully. Work out all the little details during the design phase. Learn how to use development tools. Experiment with components in the lab. *The 370 schedule leaves plenty of time for implementation, providing you have completed all aspects of design.*

Finding parts is another difficulty for students. Design your project with an Electrosonic or Active catalog beside you. Do not use parts you cannot obtain. The best design is certainly not the one which cannot be built.

> "…we believe that the number of credit hours that the course represents is grossly disproportional to the amount of work involved in implementing the project…"

You will do more than 5 credit hours work on 370-305. But do you really want to pay more for the same course? Didn't think so.

Technical Points

This is a small summary of topics which apply to all projects. You will be exposed to a mass of technical information about design and construction. The following points are reminders of the details you might overlook. Keep these pages and read them again later.

Board layout

- ✓ Lay out the components on the board. Play with them. Orient the parts so wiring will be small and neat. Don't forget the power lines and connectors. This game may take hours rather than minutes, and is well worth the effort.
- ✓ Use sockets for chips. Don't use a wire wrap socket unless you intend to wire wrap.
- ✓ Keep clock crystal circuits close to the CPU. Make the circuit as tight as possible. Do not socket a crystal, you do not want extra stray capacitance.

Construction

- ✓ First time soldering more than a few wires? Use a through-hole plated prototype board. The Radio Shack boards are much cheaper, but their solder pads come unglued after a few seconds of heating.
- ✓ Glue down connectors and sockets with 5-minute epoxy. This prevents solder joints weakening from stress. Do not get the glue on solder pads or leads.
- ✓ If in doubt, rip it out! If a wire *could* be a problem (such as insulation burned away) replace it immediately.
- ✓ Wires should be as short as possible. When a wire crosses another pad, leave just enough slack so you can move the wire aside while soldering to that pad.
- ✓ Be careful with static sensitive parts, students have zapped valuable components. Unfortunately there are no grounding straps in the lab; you will have to improvise.

Power and ground

- ✓ Always use fuses. You may need a number of fuses, such as for logic circuitry, motors, etc. Put a fuse on the terminal of any expensive batteries, too.
- ✓ Power and ground wires should be the first wires soldered onto a board. Often power and ground is distributed on bare lines running straight down the board. The power and ground for each chip run to these lines.
- ✓ Use bypass capacitors, i.e. 0.1 μF, at the power into each chip. Wire these capacitors at the same time as power and ground. A larger smoothing capacitor, such as 10 μF, is a good idea to place where power enters the board.

- ✓ The ground line must be large enough to carry the sum of all power line currents. Consideration of ground lines becomes important with higher current components, such as motors.

- ✓ Now is a very good time to put on your keyed power connector. Don't wait until after you have damaged your circuit.

- ✓ If you have more than one power supply *use different colours!*

Wire

- ✓ Use stranded wire when the wire might be bent and flexed, such as for cables. Fred has a supply of stranded wire.

- ✓ The thin wire-wrap wire is great for low-current circuitry. Observe a colour scheme, such as black and red for ground and power, blue for data, green for control, etc. Get Fred to replace the communal rolls so you always have a choice of colours.

- ✓ Use 22-gauge wire for power distribution on a board (note: I mean the main distribution lines, not to each chip!), unless your current needs are higher than a couple of amps.

Connections

- ✓ Anytime wires leave a board, use a connector. Use them now, not later: the greatest benefits of connectors is seen during prototyping.

- ✓ Use keyed connectors. If a connector can be put on the wrong way, it will happen.

- ✓ Treat yourself to switches, buttons and jumpers. Don't twist wires together, or touch a loose wire against another. Life is too short.

Don't forget that wiring, connectors, switches, etc. are all part of the design process. Figure out what you need; the construction process is less of a hassle when you have the proper parts.

Final Words

One last thing must be mentioned: in the last few weeks of the semester, live a little beyond your project. Take a break. Go out for dinner, go to a movie, have a beer, have a pop, take a walk, take a hike, and ski back down. Project courses can steal your life. Steal a few hours back.

Good luck.